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The Structural Information and Alteration Information Extraction and Metallogenic Prognosis in Laos Area

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Abstract

Remote sensing extraction of geological anomalies is one of the important research in GARS. Using ETM+ image rectification, image mosaic, color composite, color space transformation, kinds of image enhancement processing to extract structure information. Removal of interference information by mask, with principal component analysis and threshold segmentation technique for iron staining and hydroxy alteration information extraction. Four mineral potential targets has been delineated when synthetically analysing of geological information. The predicting the mineralization above provides a reference and effective way to accelerate geological prospecting work in Laos.

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1. Introduction

As the remote sensing technology in the continuous application of geological, extraction of structural information and geological anomalies are more and more used with remote sensing. In remote sensing images, linear structure often acts with a clear linear, shows straight line, curved, wavy color line. During a certain density, it forms of ribbon; commonly used methods: filter, principal component analysis etc. In 1970, U.S. GRHunt, JWSalisbury^[1] published a series of the results of visible - near infrared spectral characteristics including minerals, rocks and ore. He systematically studied the spectral properties of rocks and minerals, then analyzed these reasons of the spectral properties and discussed the spectral characteristics of different rock and influencing factors. Under the influence of the hydrothermal, wall rock alteration has the specific of spectral characteristics, ratio method, principal component analysis, SAM, MPH^[2], trace information processing method^[3] are commonly used to extract alteration information.*

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2. Laos situation

Position of Laos is in Eurasian plate and the east side of the Indian plate suture line, which crosses Changdu - Simao - Nanbang and Metallogenic province of Indo-China. In geological history, strong activities of structure - magmatic form wealth of minerals. The current information has reflected a huge potential mineral resource of Laos, which has found many of metal deposits, mining sites and mineralization.

View from the existing survey data, most of the endogenous metal mineralization such as Cu, Pb, Mo, Zn, Au, Fe related to Mesozoic magmatism. Mainly concerned with the granodiorite are Fe, Au, Cu, Pb, and other Zn mineralization. However, mineralization of Mo, Sb and Sn are mainly related with quartz monzonite and granite. In addition, weak mineralization of Au, Ag, Cu, Pb, Zn exists in Cenozoic porphyry flow of Intrusive rocks, Carbonate and Sandstone. Upper Paleozoic and Mesozoic have syngenetic layered deposits. Such as occur in the Permian Deposits of huge limestone and Jurassic sandstones of the weak copper and etc.

Laos, the main minerals are tin, iron, copper, aluminum, lead, zinc, gold, potash, precious stones, coal and oil and gas, etc^[4](fig.1).

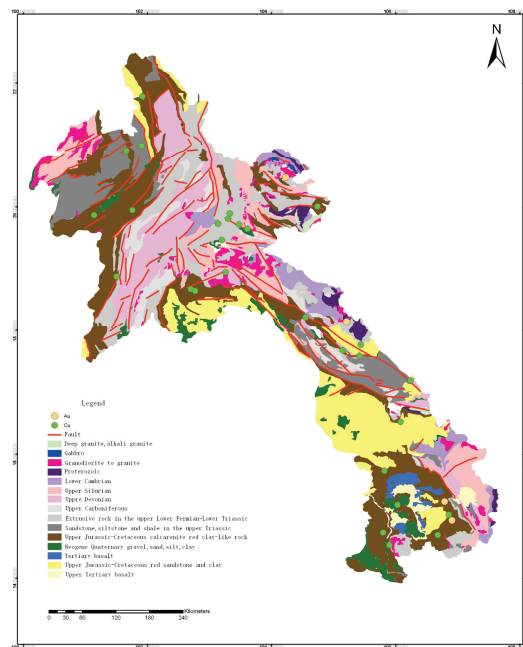


Fig.1 geological Map of 1:100 million in Laos

3. Datasets procession

Selection of the study area data

In order to extract alteration and structural information, 18 ETM+ images are selected for the work area, which have less cloud cover, good color contrast, clear texture structure from 1999 to 2001. 40 DEM data are selected, which based on the 30-meter-resolution ASTER data.

Production based remote sensing image

$$OIF = \frac{\sum_{i=1}^3 |Si|}{\sum_{i=1}^3 |CCi|} \quad (1)$$

(‘Si’ is standard deviation of gray value. the greater the ‘Si’, the greater information of the image contains. ‘CCi’ is the correlation coefficient between bands. The smaller the ‘CCi’, indicating that the smaller the redundancy between images)

Combined with the mineralization and alteration characteristics of the study area, final selection of ETM +7,4,2 bands to synthesis based image(fig.2.(a)),and DEM data in the region(fig.2.(b)).

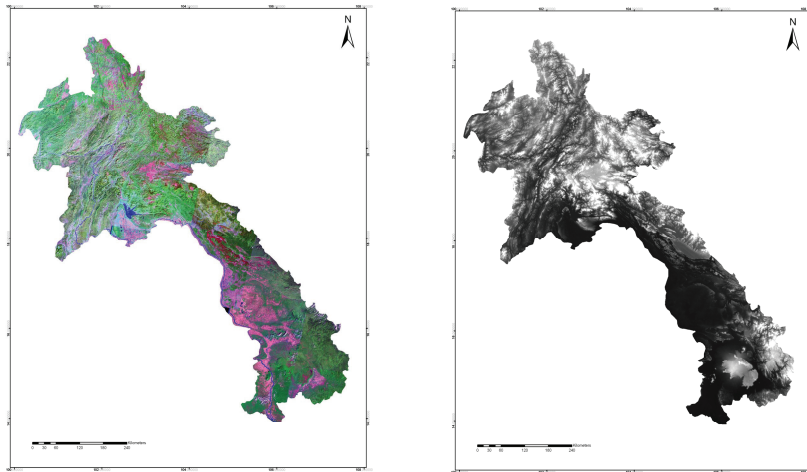


Fig.2.(a)based image;(b) the whole region of DEM

Removal of interference information

Shadows, water, vegetation and white mud land are the interference information alteration information extraction, which must be removed before alteration information extraction.

In the PCI software, band6/band1 is used as the method of water and shadow removal. Because shadows and water have similar spectral characteristics. Removal of vegetation by band3/band4 according to the spectral characteristics of vegetation. Use of high-end cutting band3 to remove white mud land^[5].

Extraction of structural information and alteration information

Extraction of structural information

Combination of remote sensing images and DEM of the mountain shadow map to interpret structural, The main method include direct interpretation and indirect interpretation. Interpretation of the results map are shown below(fig.3)

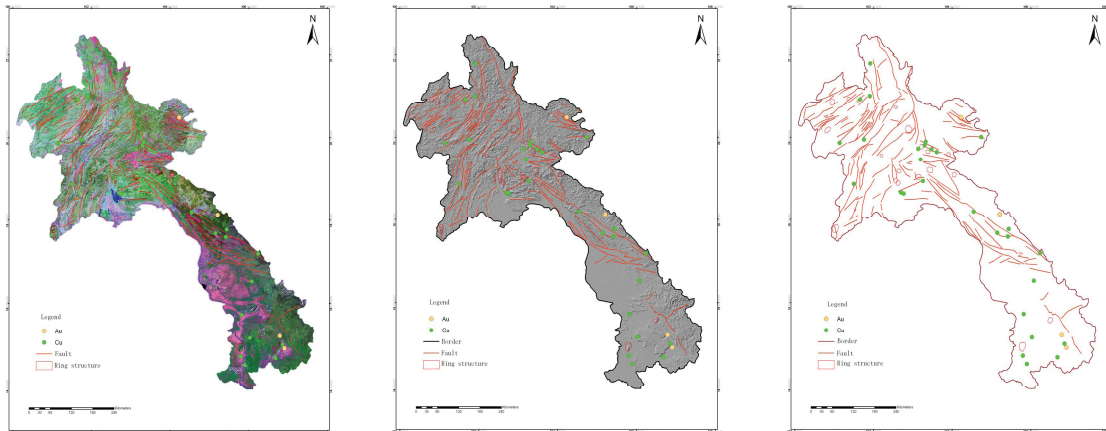


Fig.3.(a)image-based Interpretation map;(b) interpretation mapbased on DEM;(c) integrated interpretation map

Structure of the study area are mainly distributed in central and northern and distribution of groups .Learned from intensity linear structure, there are about six metallogenic high-density areas in study area.

Alteration information extraction

According to the spectral characteristics of iron-containing minerals, iron oxide has a special spectral features in the ETM +1,3,4,5 band. Therefore, the PCA is done in PCI software with the four bands above.because iron staining information has a strong absorption in ETM1 (450nm ~ 520nm) and the ETM3 (630 ~ 690nm) with a strong reflection. By analyzing the main components of PCA,abnormal concentration obtained in the PC4,alteration grading map is extracted through threshold segmentation(fig.4).

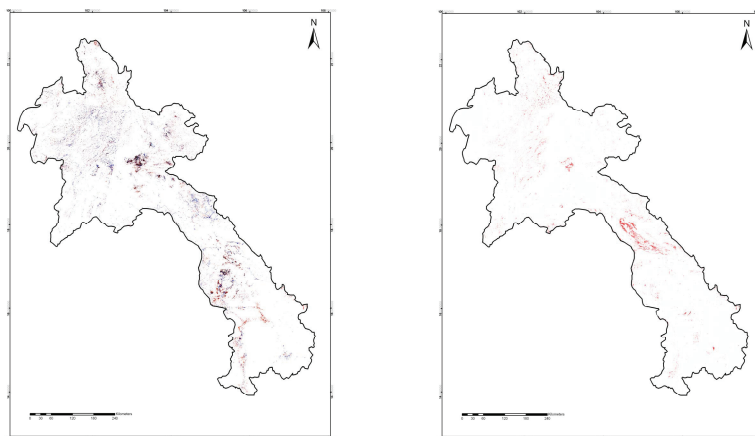


Fig.4. iron staining alteration information;(b)hydroxyl alteration information

Integrated application of multi-source information for Metallogenic prediction

4. Conclusion

- Binding processed ETM+ and DEM hillshade makes the structure interpretation more comprehensive.
- MPH extracting alteration information is possible in Laos. This method for the extraction of geological anomalies
- According to metallogenic prediction flowchart, four mineral potential targets (Oudomxay, Xieng Khouang, Khammouan, Champasak) have been delineated.

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